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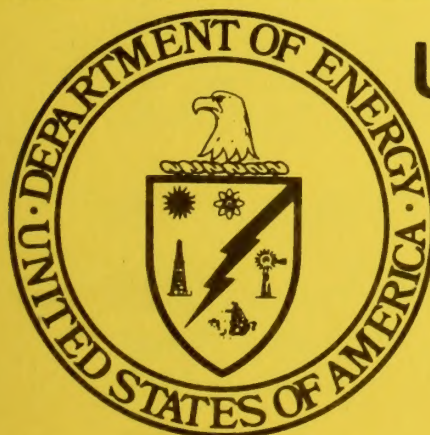
SOLAR/1040-79/04

Monthly Performance Report

SADDLE HILL TRUST

LOT 77

APRIL 1979



U.S. Department of Energy

National Solar Heating and
Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT

SADDLE HILL TRUST
LOT 77

APRIL 1979

I. SYSTEM DESCRIPTION

Saddle Hill Trust Lot 77 is a single-family residence in Medway, Massachusetts. Solar energy is used for preheating incoming city water. The solar energy system has an array of flat-plate collectors with a gross area of 78 square feet. The array faces south at an angle of 38 degrees to the horizontal. Air is used as the medium for delivering solar energy from the collector array to an air-to-liquid heat exchanger located in the collector air duct. Water is the medium used to transport solar energy from the heat exchanger to storage. Solar energy is stored in the basement in a 120-gallon preheat storage tank. This preheated city water is supplied, on demand, to a conventional 40-gallon domestic-hot-water (DHW) tank. When solar energy is insufficient to satisfy the hot water requirements, the gas-driven DHW heater provides auxiliary energy for water heating. The system, shown schematically in Figure 1, has two modes of solar operation.

Mode 1 - Collector-to-Storage: This mode activates when the difference between the temperature of the collector air and the temperature of the water in the preheat tank exceeds 40°F and the temperature of the water in the tank is below 140°F. Both the fan and pump go on. This mode continues until the temperature difference drops to 20°F.

Mode 2 - Storage-to-Space Heating: This mode activates when there is a demand for hot water. Hot water from the top of the preheat tank is transferred to the DHW tank to replace water removed. Simultaneously, city water is automatically supplied to the preheat tank.

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was occupied in April and the solar energy system operated continuously during the month. Solar energy satisfied 33 percent of the DHW requirements. The solar energy system provided fossil fuel energy savings of 1.0 million Btu and incurred an electrical energy expense of 0.12 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 2.9 million Btu for a daily average of 1239 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during April of 1372 Btu per square foot for a south-facing plane with a tilt of

- I001 COLLECTOR PLANE TOTAL INSOLATION
- ▲ T001 OUTDOOR TEMPERATURE

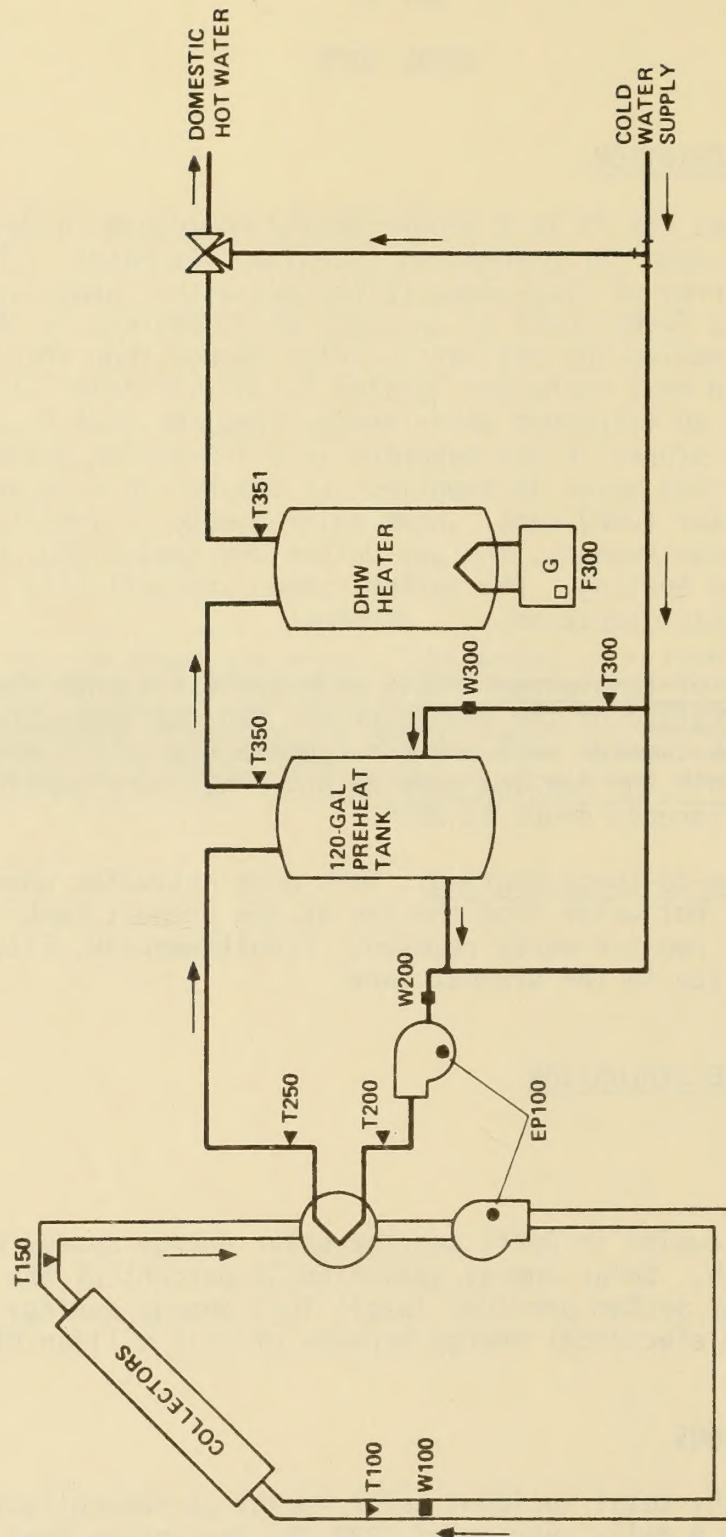


Figure 1. SADDLE HILL TRUST, LOT NO. 77, SOLAR ENERGY SYSTEM SCHEMATIC

42 degrees to the horizontal. The average ambient temperature during April was 47°F as compared with the long-term average for April of 49°F.

THERMAL PERFORMANCE

System - During April the solar energy system performed approximately the same as expected. The expected performance was determined from a modified f-chart analysis using measured weather and subsystem loads as inputs. Solar energy collected was 0.87 million Btu versus an estimated 0.69 million Btu. Solar energy used by the system was estimated by assuming that all energy collected would be applied to the load. Actual solar energy used was 0.67 million Btu. System total solar fraction was 33 percent versus an estimated 32 percent.

Collector - The total incident solar radiation on the collector array for the month of April was 2.9 million Btu. During the period the collector loop was operating the total insolation amounted to 2.4 million Btu. The total collected solar energy for the month of April was 0.87 million Btu, resulting in a collector array efficiency of 30 percent, based on total incident insolation. Solar energy delivered from the collector array to the DHW subsystem amounted to 0.67 million Btu. Energy loss during transfer from the collector array to the DHW subsystem was 0.20 million Btu. This loss represented 23 percent of the energy collected. Operating energy required by the collector loop was 0.12 million Btu.

DHW Load - The DHW subsystem consumed 0.67 million Btu of solar energy and 2.5 million Btu of auxiliary fossil fuel energy to satisfy a hot water load of 1.8 million Btu. The solar fraction of this load was 33 percent. Losses from the DHW subsystem were 0.37 million Btu. A daily average of 73 gallons of DHW was consumed at an average temperature of 141°F delivered from the tank.

OBSERVATIONS

The losses from the DHW subsystem were partly attributed to the relatively high DHW average temperature of 141°F.

ENERGY SAVINGS

The solar energy system provided a fossil fuel energy savings of 1.0 million Btu and incurred an electrical energy expense of 0.12 million Btu.

III. ACTION STATUS

No action is required at this time.

SCLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053 SOLAR/1039-79/04
 REPORT PERIOD: APRIL, 1979

SITE/SYSTEM DESCRIPTION:
 THE SADDLE HILL TRUST, LOT 77, SCLAR SYSTEM PROVIDES YEAR ROUND HOT WATER TO A SINGLE FAMILY DETACHED HOUSE. THE COLLECTOR IS A FOUR-PANEL AIR COLLECTOR. STORAGE IS A 120 GALLON WATER TANK. AUXILIARY HOT WATER IS PROVIDED BY A GAS DOMESTIC HOT WATER HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY 2.900 MILLION BTU
 COLLECTED SOLAR ENERGY 37175 BTU/SQ.FT.
 AVERAGE AMBIENT TEMPERATURE 0.874 MILLION BTU
 AVERAGE BUILDING TEMPERATURE 11211 BTU/SQ.FT.
 ECSS SOLAR CONVERSION EFFICIENCY N.A.
 ECSS OPERATING ENERGY 47 DEGREES F
 TOTAL SYSTEM OPERATING ENERGY 0.23
 TOTAL ENERGY CONSUMED 0.117 MILLION BTU
 3.462 MILLION BTU

SUBSYSTEM SUMMARY:

LOAD	HOT WATER	HEATING	COOLING
SOLAR FRACTION	1.771	N.A.	N.A.
SOLAR ENERGY USED	33	N.A.	N.A.
OPERATING ENERGY	0.672	N.A.	N.A.
AUX. THERMAL ENERGY	N.A.	N.A.	N.A.
AUX. ELECTRIC FUEL	1.482	N.A.	N.A.
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.
ELECTRICAL SAVINGS	2.471	N.A.	N.A.
FOSSIL SAVINGS	-0.117	N.A.	N.A.
	1.001		

SYSTEM TOTAL
 1.771 MILLION BTU
 33 PERCENT
 0.672 MILLION BTU
 0.117 MILLION BTU
 1.482 MILLION BTU
 N.A. MILLION BTU
 2.471 MILLION BTU
 -0.117 MILLION BTU
 1.001 MILLION BTU

SYSTEM PERFORMANCE FACTOR:

0.619

* DENOTES UNAVAILABLE DATA
 @ DENOTES NULL DATA
 N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
 OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978.
 SOLAR/0004-7E/1E

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: APRIL, 1979

SOLAR/1039-79/04

SITE/SYSTEM DESCRIPTION:

THE SADDLE HILL TRUST, LOT 77, SOLAR SYSTEM PROVIDES YEAR ROUND HOT WATER TO A SINGLE FAMILY DETACHED HOUSE. THE COLLECTOR IS A FOUR-PANEL AIR COLLECTOR. STORAGE IS A 120 GALLON WATER TANK. AUXILIARY HOT WATER IS PROVIDED BY A GAS DOMESTIC HOT WATER HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE

AVERAGE BUILDING TEMPERATURE

ECSS SOLAR CONVERSION EFFICIENCY

ECSS OPERATING ENERGY

TOTAL SYSTEM OPERATING ENERGY

TOTAL ENERGY CONSUMED

3.059 GIGA JOULES
422165 KJ/SQ.M.
0.923 GIGA JOULES
127317 KJ/SQ.M.
8 DEGREES C
N.A. DEGREES C
0.23

0.124 GIGA JOULES
0.124 GIGA JOULES
3.653 GIGA JOULES

SUBSYSTEM SUMMARY:

LOAD
SOLAR FRACTION
SOLAR ENERGY USED
OPERATING ENERGY
AUX. THERMAL ENG
AUX. ELECTRIC FUEL
AUX. FCSSIL FUEL
ELECTRICAL SAVINGS
FCSSIL SAVINGS

HOT WATER
1.868
33
0.709
N.A.
1.564
N.A.
2.606
-0.124
1.056

HEATING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

COOLING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM TOTAL
1.868 GIGA JOULES
33 PERCENT
0.709 GIGA JOULES
0.124 GIGA JOULES
1.564 GIGA JOULES
N.A. GIGA JOULES
2.606 GIGA JOULES
-0.124 GIGA JOULES
1.056 GIGA JOULES

SYSTEM PERFORMANCE FACTOR:

0.619

* DENOTES UNAVAILABLE DATA
DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: SADDLE HILLS TRUST LCT #77, MEDWAY, MA 02053
 REPORT PERIOD: APRIL, 1979
 SCLAR/1039-79/04

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SCLAR CONVERSION EFFICIENCY
1	0.023	45	0.002	N	0.000	N	0.092
2	0.005	38	0.000	O	0.000	T	0.000
3	0.023	42	0.003	T	0.000		0.113
4	0.078	40	0.022	A	0.004		0.287
5	0.025	40	0.002	P	0.000		0.077
6	0.108	38	0.028	P	0.003		0.263
7	0.089	37	0.018	L	0.006		0.204
8	0.190	35	0.048	L	0.000		0.254
9	0.006	35	0.000	I	0.003		0.000
10	0.072	39	0.014	C	0.007		0.190
11	0.192	45	0.048	A	0.007		0.250
12	0.166	49	0.047	E	0.007		0.281
13	0.142	43	0.027	L	0.005		0.190
14	0.016	38	0.000	E	0.001		0.000
15	0.037	41	0.001		0.000		0.017
16	0.027	41	0.000		0.000		0.015
17	0.088	42	0.023		0.005		0.260
18	0.141	44	0.041		0.006		0.288
19	0.107	44	0.029		0.007		0.271
20	0.171	45	0.044		0.007		0.258
21	0.187	49	0.025		0.006		0.135
22	0.108	52	0.023		0.005		0.214
23	0.177	59	0.030		0.007		0.171
24	0.177	58	0.058		0.007		0.329
25	0.104	60	0.008		0.005		0.075
26	0.099	63	0.017		0.006		0.167
27	0.014	61	0.001		0.000		0.053
28	0.116	64	0.041		0.006		0.350
29	0.062	60	0.022		0.004		0.360
30	0.147	62	0.050		0.007		0.340
SUM	2.900	-	0.672	N.A.	0.117	N.A.	-
AVG	0.097	47	0.022	N.A.	0.004	N.A.	0.232
NBS ID	G001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
 & DENOTES NULL DATA.
 N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT COLLECTOR ARRAY PERFORMANCE

SITE: SADDLE HILLS TRUST LCT #77, MEDWAY, MA 02053 SOLAR/1039-79/04
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.023	0.005	0.003	45	0.110
2	0.005	0.000	0.000	38	0.000
3	0.023	0.006	0.003	46	0.134
4	0.078	0.058	0.026	51	0.330
5	0.025	0.004	0.002	43	0.090
6	0.108	0.086	0.033	46	0.304
7	0.089	0.056	0.022	40	0.243
8	0.190	0.178	0.058	45	0.305
9	0.006	0.000	0.000	35	0.000
10	0.072	0.045	0.017	43	0.231
11	0.152	0.180	0.058	54	0.300
12	0.166	0.155	0.055	58	0.332
13	0.142	0.136	0.036	57	0.250
14	0.016	0.000	0.000	42	0.000
15	0.037	0.006	0.001	46	0.038
16	0.027	0.001	0.001	46	0.024
17	0.088	0.078	0.028	52	0.322
18	0.141	0.127	0.049	55	0.345
19	0.107	0.094	0.035	55	0.331
20	0.171	0.155	0.054	61	0.316
21	0.187	0.174	0.056	70	0.297
22	0.108	0.092	0.029	65	0.271
23	0.177	0.166	0.055	74	0.312
24	0.177	0.165	0.065	73	0.368
25	0.104	0.088	0.027	77	0.263
26	0.099	0.089	0.030	72	0.305
27	0.014	0.001	0.001	61	0.058
28	0.116	0.110	0.047	76	0.403
29	0.062	0.053	0.025	65	0.399
30	0.147	0.139	0.060	73	0.405
SUM	2.900	2.446	0.874	-	-
AVG	0.097	0.082	0.029	56	0.302
NBSID	0001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: APRIL, 1979

SOLAR/1039-79/04

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.CF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	COPER ENERGY MILLION BTU	AUX THERMAL MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FCSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FCSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.045	22	0.002	NCT	0.053	NCT	0.088	-0.000	0.007	49	148	50
2	0.056	10	0.000		0.063		0.105	0.000	0.000	47	143	69
3	0.068	7	0.003		0.059		0.099	-0.000	0.007	46	143	85
4	0.068	12	0.022		0.075		0.125	-0.004	0.018	48	145	82
5	0.056	18	0.002		0.039		0.066	-0.000	0.014	50	141	70
6	0.110	22	0.028		0.096		0.160	-0.003	0.046	48	138	142
7	0.051	14	0.018		0.055		0.092	-0.006	0.014	48	141	60
8	0.045	33	0.048		0.039		0.065	-0.000	0.034	48	142	56
9	0.059	41	0.000		0.045		0.075	0.000	0.038	51	136	76
10	0.125	34	0.014		0.084		0.141	-0.003	0.050	48	143	152
11	0.032	30	0.048		0.031		0.052	-0.007	0.021	49	144	39
12	0.077	50	0.047		0.054		0.090	-0.007	0.063	48	142	94
13	0.000	0	0.027		0.011		0.018	-0.005	0.000	52	141	0
14	0.000	0	0.000		0.016		0.027	-0.000	0.000	52	141	0
15	0.003	9	0.001		0.016		0.027	-0.001	0.002	51	140	4
16	0.062	33	0.000		0.039		0.065	-0.000	0.032	48	140	83
17	0.173	35	0.023		0.119		0.199	-0.005	0.095	48	146	166
18	0.065	28	0.041		0.065		0.108	-0.006	0.038	50	145	97
19	0.054	32	0.029		0.052		0.087	-0.006	0.036	49	141	69
20	0.055	38	0.044		0.048		0.081	-0.007	0.046	50	142	72
21	0.049	66	0.025		0.026		0.043	-0.006	0.056	47	139	62
22	0.015	45	0.023		0.023		0.039	-0.005	0.013	50	138	19
23	0.131	56	0.030		0.078		0.130	-0.007	0.132	47	142	167
24	0.039	40	0.058		0.034		0.056	-0.007	0.022	47	144	50
25	0.020	36	0.008		0.022		0.036	-0.005	0.018	51	138	26
26	0.044	38	0.017		0.033		0.056	-0.006	0.036	55	139	57
27	0.057	40	0.001		0.047		0.078	-0.000	0.040	49	145	74
28	0.064	38	0.041		0.046		0.077	-0.006	0.048	51	143	83
29	0.057	37	0.022		0.073		0.121	-0.004	0.048	53	137	127
30	0.043	15	0.050		0.040		0.066	-0.007	0.020	55	135	61
SUM	1.771	-	0.672	N.A.	1.482	N.A.	2.471	-0.117	1.001	-	-	2193
AVG	0.059	33	0.022	N.A.	0.049	N.A.	0.082	-0.004	0.033	50	141	73
NBS	Q302	N300	G300	G303	G301	G305	G306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NCT APPLICABLE DATA.

SCLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENVIRONMENTAL SUMMARY

SCLAR/1039-79/04

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	TOTAL INCLINATION BTU/SQ.FT	DIFFUSE INCLINATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	292	NCT	45	45	NOT	NCT	NOT
2	69		38	46			
3	296		42	51			
4	1002	APPLI	40	43	APPLI	CA	B
5	322		40	46			
6	1380		38	40			
7	1147		37	45			
8	2441		39	35			
9	75		39	43			
10	927		45	54			
11	2461		45	58			
12	2123		43	57			
13	1826		38	42			
14	207	CABLE	41	46	CABLE	E	
15	471		41	46			
16	345		42	53			
17	1128		44	55			
18	1806		44	55			
19	1368		44	61			
20	2191		45	70			
21	2403		49	65			
22	1389		52	74			
23	2275		55	73			
24	2270		58	72			
25	1335		60	77			
26	1275		63	72			
27	175		61	61			
28	1490		64	76			
29	1793		60	65			
30	1687		62	73			
SUM	37175	N.A.	-	-	-	-	-
AVG	1239	N.A.	47	56	N.A.	N.A.	N.A.
NBS ID	0001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
 & DENOTES NULL DATA.
 N.A. DENOTES NOT APPLICABLE DATA.

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